UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS

Operations Guidance Report on

WATER FACILITIES FOR

YAMHILL DRAINAGE BASIN

OREGON

Prepared by

WATER UTILIZATION SECTION
DIVISION OF LAND ECONOMICS

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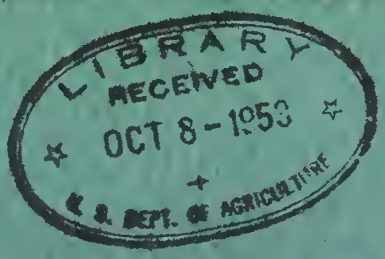

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ACKNOWLEDGMENTS

The following agencies, organizations, and individuals, either by printed reports, buildings, or personally, have contributed to this report: Oregon State College at Corvallis; State Engineer of Oregon; United States Geological Survey, Ground Water and Surface Water Divisions; United States Weather Bureau; Pacific Pump Company; Soil Conservation Service; Oregon State Planning Board; State Bureau of Agricultural Economics representative; officials of the various counties; and farmers in the area. This assistance is gratefully acknowledged.

AUTHORIZATION

This report is compiled under the authority of an act "To promote conservation in the arid and semiarid areas of the United States by aiding in the development of facilities for water storage and utilization, and for other purposes" (Public Law No. 399, 75th Congress, approved August 28, 1937). The act further sets out: "Section II, Paragraph (1)--The facilities to be included within such a program shall be located where they will promote the proper utilization of lands, and no such facilities shall be located where they will encourage the cultivation of lands which are submarginal and which should be devoted to other uses in the public interest - - -."

The northwestern portion of the State of Oregon, although not within an arid or semiarid area, is subject to frequent recurrence of unusually dry summers. Precipitation is unevenly distributed, and in some years almost entirely lacking during the growing season. The area will be aided by the development of facilities for water utilization through irrigation. Therefore, the Water Facilities Board, in October 1938, authorized the Yamhill drainage basin in Yamhill and Polk counties, Oregon, for area planning and operations.

LIST OF TABLES

MAP

YAMHILL DRAINAGE BASIN

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SUMMARY

1. The average total annual precipitation would be sufficient for abundant production, if more evenly distributed through the year.

2. The unseasonable distribution of precipitation makes irrigation necessary for maximum crop production.

3. The duty of water varies chiefly with the type of soil and type of crop. The average duty is 18 inches during irrigation season.

4. The water supply from stream flow is relatively small during the summer season, thus limiting irrigation development unless storage is provided.

5. Within this limitation, direct diversion and pump irrigation are economically feasible.

6. Storage of water for extensive irrigation is necessary.

7. Tests over a period of years by the Oregon State College have convincingly demonstrated that irrigation gives increased returns consistent with its cost.

8. The basin is adapted to a large variety of crops, with limitations in some areas imposed by soil conditions. The principal present crops are [illegible] grain, hay, and [illegible]

orchards and other specialized crops forming a small percentage of the total. There is a definite indication of a trend toward smaller units.

9. Three land problems are apparent. None, however, has reached the stage of being critical. They are, namely: (1) settlement on logged-over hill lands or other lands unadapted to agricultural cropping; (2) uneconomic farm units, due to small acreage; (3) sheet erosion on hill soils.

10. Many of the low income operators located on small acreage units will be in a position to increase their annual production with water facility development. Experience has indicated that some crops will more than double their yields if irrigated. Operators using irrigation estimate they can afford to pay six to seven dollars per acre per year for irrigating general crops, such as ladino clover pasture and alfalfa. The average amount that can be economically expended for more intensive crops is not known. Under favorable circumstances, however, it can be more than seven dollars per acre per year.

11. It is recommended that approximately 1,000 acres in the Willamina Valley be irrigated by direct diversion from Willamina Creek.

12. It is recommended that further development by pump irrigation from Salt Creek be curtailed until the owners enter into a mutual agreement pertaining to the use and amount of available water supply.

13. Pump irrigation from perennial streams in the Yamhill Basin should be limited to the available water supply, and the cost

be justified by the increase in production.

14. As the Yamhill Drainage Basin, taken collectively, has a greater demand for water for all purposes than the amount available during the months of July, August, and September, irrigation development should proceed under mutual agreement for rotation of service, or, if such agreement is not practicable, with the understanding and recognition of the fact that full season service will not be available.

I

PURPOSE AND SCOPE

The Oregon Agricultural Experiment Station, for nearly 30 years, has conducted experiments which have convincingly demonstrated the advantages of irrigation in the Willamette Valley. The Oregon State Planning Board has been particularly interested in studies for irrigation development along this Valley. These investigations have shown the increase in value of small berry and field crops grown under irrigation. The agricultural agencies operating in the State, realizing that the Yamhill River Basin, which is a part of the Willamette Drainage Basin, is adaptable to development by gravity and pump irrigation under the Water Facilities Program, recommended it to the Water Facilities Board for area planning and immediate operations.

The purpose of this report is to furnish information for the general guidance of the operating agencies in the development of water facilities in the Yamhill Area. In addition it points out general agricultural problems, some of which can be at least partially solved by water facilities development.

The report on the Yamhill Drainage Basin deals particularly with the drainage of Willamina Creek and Salt Creek, which are tributaries of the Yamhill River.

The data and material for the report were obtained from field surveys, soil survey maps, publications of the Oregon State College, United States Geological Survey, Oregon State Planning Board, State Engineer, personal interviews with farmers, and various other sources.

The report was compiled by the Water Utilization Section, Division of Land Economics, Bureau of Agricultural Economics.

The report consists of a narrative that describes generally the cultural, physical, and economic characteristics of the area. Water resources, irrigation possibilities, and geology are discussed in detail. The map showing the physical features, and proposed irrigation development is attached to the report.

II

DESCRIPTION OF THE AREA

Location and Size

The Yamhill Drainage Basin is located in the northwestern part of the State of Oregon in Polk and Yamhill counties. The area is bounded on the east by the Willamette River, on the west by the Coast Range, on the north by the divide between the Yamhill and Tualotin River Watersheds, and on the south by the divide between the Yamhill River and Rickreall Creek Watersheds. The area of the basin is approximately 800 square miles.

The elevation varies from about 1,000 feet at the top of the Coast Range to about 100 feet at the junction of the Yamhill and Willamette Rivers.

Economic Development

The Yamhill area is a part of the Willamette Drainage Basin, a highly developed agricultural portion of the State.

The Willamette Valley has been described as "a compact region, set off from the rest of the State by natural boundaries and surrounded by areas of entirely different physiography and climate. Numerous cities, towns and rural communities have been established.

Railroads, highways and communications, electric power services, schools, churches, and other public improvements have been built."[1]

Agriculture is the principal industry in this immediate area, but some lumbering is also done. In addition to full-time agriculture, many smaller part-time units are located in the area.

Climatic Conditions

The area has a wide variety of climate. Its location, between the high Cascades on the east and the Coast Range on the west, paralleling the Pacific Ocean, gives the climate a marine influence, whereas the high mountains furnish a continental influence. The mountain ranges, by prohibiting the free interchange of air currents, influence the temperature and moisture content of the air.

Precipitation

At various times, there have been several weather stations located in the Yamhill Basin, dating as far back as 1856. The McMinnville station in Yamhill County has been maintained continuously since 1888. This station is located in the east central portion of the basin, and is not applicable to the entire basin, but is indicative of the more intensive agricultural area. The average annual precipitation

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[1] "Land Development in Oregon Through Flood Control, Drainage and Irrigation," Oregon State Planning Board, July 1938.

annually. Approximately 80 per cent of the precipitation occurs during the 6-month period, October to March, inclusive. For the period including April, May, and June, approximately 14 per cent occurs. Only 6 per cent or 2.85 inches of precipitation occurs during July, August, and September, while during the months of July and August less than one inch normally occurs. During the year 1931 there was no precipitation during July and August. For the months of May, June, July, and August, 1938, there was only six-tenths of an inch of precipitation, and 3.51 inches for the 6-month period, April 1 to September 30.

Temperature[1]

The mean annual temperature is 52 degrees. The average maximum temperature is 64 degrees and the average minimum is 41 degrees. The temperature varies from 110 degrees above zero to 24 degrees below zero. There are approximately 140 rainy days per year. The average growing season is 180 days.

Wind

The prevailing wind direction is southwest.

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[1] 1940 Climatic Summary, U. S. Weather Bureau.

Evaporation[1]

The average monthly evaporation in inches for 8 years of record at Corvallis, Oregon, is as follows:

April	May	June	July	August	September	Total
3.106	4.094	5.253	6.747	6.452	3.904	29.556

This total is indicative of the evaporation that may occur at McMinnville.

Topography and Drainage

Yamhill River Drainage Basin is dominated on the west by the Coast mountain range, an irregular group of maturely dissected hills which rise 700 to 1,000 feet above the valley floor. Within the basin, land forms consist of low stream terraces, broad valley or flood plain terraces, rolling uplands, and roughly rolling to mountainous hills. The most striking feature is the nearly level extensive valley terrace, which lies mostly south of, but adjacent to the Yamhill at an elevation of about 60 feet above river level. Approximately 20 feet above the river, another terrace elevation of considerable extent occurs.

The region is drained by the Yamhill River and its tributaries, which discharge these surface waters originating in the area into

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[1] Yearly Climatological Data, U. S. Weather Bureau.

Willamette River at the eastern border of the basin. The headwaters of Yamhill River and tributaries are rapidly falling, typical mountain streams. In its middle and lower portions, the Yamhill falls 5 to 12 feet per mile in a channel cut 30 to 60 feet below the general valley flood level.

Salt Creek Tributary

Surface expression within the Salt Creek Basin Tributary of Yamhill River consists of small, low stream terraces, extensive level flood plain areas along the west and northern portions, and rolling uplands merging into maturely dissected, roughly rolling, or mountainous hills which form the divides. Low stream terraces lie within 20 feet of the creek bottom, while flood plain elevations vary mainly between 25 and 60 feet. There is a similarity between the gradients of Salt Creek and those of Yamhill and Willamette Valleys. Divides rise as much as 400 feet above the valley floor.

The main stem of Salt Creek occupies a narrow, moderately shallow trench. Tributary valleys originating in the mountainous regions form small canyons in their upper reaches, but commonly become shallow drains as they approach Salt Creek. The upper part of Salt Creek falls approximately 65 feet per mile; the lower two-thirds about 4 feet per mile. In this lower portion, the stream channel is generally U-shaped, measuring approximately 40 feet in width, and 5 to 8 feet in depth.

Willamina Creek, a principal tributary of Yamhill River, occupies a narrow to moderately broad mountain valley. Land forms consist of valley terraces lying 15 to 40 feet above the stream channel, rolling intermediate slopes, mountainous hills, and rolling to roughly rolling upland areas located as much as 450 feet above the valley floor. The entire basin is maturely dissected by Willamina Creek and its tributaries, which are typical mountain streams. In its upper portions, the main stream falls 50 to 75 feet per mile, while in the lower reaches a fall of approximately 20 feet per mile was observed.

Geology and Ground Water

Geologic materials exposed are Tertiary in age and belong to the Eocene, Oligocene, and Miocene series of rocks. These rocks are composed mainly of light to dark, blue, gray, brown, red, and buff, medium to fine grained marine, clays, shales, and sandstones, much of which are tuffaceous (contain volcanic ash). Clay and shale are the predominant materials. Sandstone and a few thin gravels occur in subordinate quantities. Intrusive igneous (volcanic) rocks composed largely of basalt and diabase are associated mainly with Miocene materials and outcrop frequently in the valley floor and on the intermediate slopes. Their occurrence is chiefly responsible for the mountainous divides. Alluvial materials of Quarternary age, composed of clay and silt, with lesser quantities of sand, gravel, and boulders, occur associated with stream, valley, and flood plain terraces.

Ground waters occur primarily in joint and fracture planes of tuffaceous, sandy clays and shales, and in interstices of alluvial deposits along stream valleys. Joint and fracture planes and vesicles in igneous rocks provide for the storage of ground water in some cases. A few wells have encountered sand and gravel.

Ground waters are nearly everywhere recoverable in the area by means of pumped wells from depths seldom exceeding 100 feet. The waters are generally usable in quality, although deeper wells and a few shallow wells usually recover waters containing soluble mineral salts in objectionable quantities. Recoverable quantities of water are reported to vary between 5 and 20 gallons per minute. Larger quantities cannot be expected except near the junction of Yamhill and Willamette Rivers in a general region popularly known as Dayton Flats. Elsewhere, the economic recovery of quantities of water sufficient for irrigation purposes is exceedingly doubtful.

Dayton Flats, a nearly level plain, represents a flood plain or terrace elevation formed by the Yamhill and Willamette Rivers near

to about the vicinity of McMinnville, should present ground-water characteristics much like those of the flats.

At other locations on Willamette River under similar geologic and hydrologic conditions, water for irrigation purposes is being recovered from pumped wells. In the Dayton area, therefore, the recovery of 200 gallons per minute or more at a pumping head of 50 to 80 feet appears feasible. However, variability of water bearing materials makes the occurrence of satisfactory ground water supplies for irrigation highly unpredictable. Test drilling and pumping will be required to ascertain the dependability of water supply, and to determine total pumping heads at safe yield capacities. A high pumping head may preclude the possibility of irrigating from pumped wells even though a satisfactory water supply is available.

Ground waters are not subject to legislative control in this region. This fact, together with the uncertainty of sufficient, dependable, and economically recoverable ground waters, requires that contemplated development proceed conservatively and under close observation.

Springs occur abundantly in the hilly and mountainous regions, especially in the western part of the basin. Yields are reported to vary mainly between 2 and 25 gallons per minute. With few exceptions, the quality of spring water is excellent. Many springs have been developed for domestic and for stock water use.

Willamina Creek Tributary

The mountain valley of Willamina Creek is enclosed mainly by clay, shale, basalt, and diabase of the Miocene series. Alluvial material composed of clay, silt, sand, gravel, and boulders occupy the valley slopes and floor.

Ground waters here occur chiefly in alluvial materials. Some waters are available in the sandy, tuffaceous zones of clay and shale, and to a very limited extent in the igneous rocks. Many springs are present along valley walls and intermediate slopes. A few of these are reported to dry up during the late summer, but for the most part they are perennial. Unsuccessful wells are not reported in this valley.

At present, domestic water in Willamina Valley is furnished largely by springs and to a lesser extent by pumped wells. Stock water is supplied from surface flow, ponds, springs, and pumped wells.

Conclusions and Recommendations.—

1. Satisfactory supplies of ground water for livestock and domestic uses are everywhere available, either from springs or pumped wells, with but rare exception. Few wells will exceed 50 feet in depth.

2. A deficiency of livestock and domestic water is not apparent.

3. The only practical application of the Water Facilities Program to the ground-water resources of the basin is the development or improvement of a few springs and wells. This development in this area

to the Water Facilities Program.

Salt Creek Tributary

The moderately broad valley of Salt Creek is underlain almost entirely by clay and shale with subordinate amounts of sand. The more rugged topographic features contain large amounts of basalt.

Ground waters here occur primarily in sandy, tuffaceous shales and clays, and in alluvial materials. Wherever present, stringers or lentils of sand and gravel also bear ground water.

Ground waters are recovered by springs and pumped wells. Numerous springs occur along valley walls and intermediate slopes, chiefly in the mountainous regions. Although some dry up during the late summer, the greater number are perennial.

Several unsuccessful wells are reported in the area, and although the exact number was not ascertained, there are probably not more than ten. The majority of these encountered an insufficient water supply, a few were dry holes, and the remainder encountered the so-called "salt water."

At present, domestic water is furnished by wells and springs, and livestock water by surface flow, ponds, wells, and springs. Since many surface streams go dry during the late summer months, pumped wells and springs constitute the most reliable supply.

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Conclusions and Recommendations.—

1. Satisfactory supplies of ground water for livestock and domestic use are almost everywhere available from pumped wells and gravity springs. Few wells will exceed 100 feet in depth.

2. Although local areas have difficulty in obtaining a satisfactory ground-water supply, the deficiency is not acute.

3. It is believed that unsuccessful wells, in a large measure, are due to improper location, construction, and development.

4. A detailed geologic and hydrologic examination of local areas reported to be barren, plus recommendations for construction and development of wells, should result in the improvement of many ground-water supplies.

5. Irrigation of more than garden tracts ($\frac{1}{4}$ to 1 acre) from pumped wells is not to be expected. The quality of water in some cases will preclude this development.

6. The only practical application of the Water Facilities Program to the ground-water resources of the basin is the development, or improvement, of a few wells and springs. In part at least, this development in this area seems better adapted to the Agricultural Conservation Program than to the Water Facilities Program.

Surface Water

Gaging Stations

Gaging stations are located on the Yamhill River at Lafayette; on the South Yamhill near Willamina; on Willamina Creek 4 miles north

of Willamina; and on Haskins Creek above Idlewild Creek near McMinnville.

Water Supply

Only the water supply for Willamina Creek and Salt Creek for the 6-month period, April 1 to September 30, will be discussed in detail. The following tabulation gives the mean run-off in cubic feet per second by months for the station on Willamina Creek 4 miles north of the City of Willamina, for the years of record.[1]

TABLE 1.--MEAN MONTHLY RUN-OFF IN CUBIC FEET PER SECOND

Years	April	May	June	July	August	September
1934			34.2	18.2	12.5	12.5
1935	261	103	42.7	24.6	14.4	15.4
1936	172	142	76.1	32.9	16.9	15.4
1937	544	168	98.8	45.9	24.5	20.2
1938	274	108	45.8	20.7	12.5	12.0

Table 2 shows the number of days, by months, that the daily flow of Willamina Creek is 20 cubic feet per second, or less. The table summarizes, by days, the flow of 10 cubic feet per second, or less, daily, increasing by intervals of 2 cubic feet per second, daily.

Willamina Creek is typical of the streams of western Oregon whose sources are in the higher altitudes. A large part of the run-off occurs during the months of greatest precipitation, and recedes rapidly as the precipitation decreases. Due largely to geologic

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[1] Geological survey - Water Resources Branch.

TABLE 2.—DAILY FLOW OF WILLAMINA CREEK

(By number of days per month that the discharge in cubic feet per second is 10 cubic feet or less, 12 cubic feet or less, etc., to 20 cubic feet.)

Year	July						August						September						Total for the 3 months					
	10	12	14	16	18	20	10	12	14	16	18	20	10	12	14	16	18	20	10	12	14	16	18	20
1934			1	8	18	24	4	18	26	30	31	31	6	19	25	28	29	30	10	37	52	66	78	85
1935				6	14		1	7	20	24	28	30	12	18	24	26	27	27	13	25	44	50	61	71
1936								3	7	27	31		3	16	23	27	28		3	19	30	54	59	
1937											8				6	14	19				6	14	27	
1938			8	15	17	18	21	28	30	31	31		11	25	26	27	29	30	11	46	62	72	77	79

characteristics, there is little recharge to the streams by springs or seepage. The daily water supply for irrigation without storage is limited. During the summer months, streams that have their source in the foothills or lower altitudes become intermittent or dry as they reach the valley floor.

There are no gaging stations on Salt Creek, but farmers residing along the streams state that it is dry during the months of low precipitation. Ponding, therefore, is required for water supply for pump irrigation.

Water Rights

Willamina Creek.--The first water permit for 0.62 cubic feet per second, (66 irrigable acres) from Willamina Creek, is dated May 28, 1931. The city of Willamina has the next priority, February 15, 1932, for which a certificate of appropriation for two-tenths cubic feet per second has been issued for municipal purposes.[1] There have been four certificates of appropriation, three permits issued, and five applications pending, or a total of twelve filings in good standing for water rights from Willamina Creek and its tributaries.[2] The total of all filings for irrigation, municipal, and domestic, is 43.125 cubic feet per second, plus four acre-feet storage for a log

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[1] Certificate Book Vol. 11 State Engineer's office.

[2] Plat Record Water Rights Dist. 1, 2, 3, 4 - State Engineer's office.

pond, and an undetermined amount for boilers for a sawmill. Included in the total of 45.125 cubic feet are 40 cubic feet per second to irrigate 1,000 acres, under a Water Facilities proposal. In addition to the above filings, the Portland General Electric Company has a hydroelectric plant on Willamina Creek which requires approximately 150 cubic feet per second. The plant has been in use many years, and although they have not filed for use of the water, their vested right is recognized under the Oregon State Water Code. The Portland General Electric Company has each year, for the consideration of one dollar, waived its vested right during the irrigation season to the Willamina water users for irrigation.[1]

Allowing one-eightieth of a cubic foot per second for one acre, which is considered sufficient for irrigation in the State of Oregon, the net requirement to meet the demands of all appropriations, except the power company, is 15.625 cubic feet per second.[2] In the preceding paragraphs, it has been shown that during 5 years of record there is adequate flow in Willamina Creek to supply the demand, except for several days during the months of July, August, and September. During this 3-month period there are 16 cubic feet per second of water, or less, passing the gaging station 49 per cent of the days. To augment the requirement for irrigation of 1,000 acres under the proposed Water Facilities project, it will be necessary for the prior appropriators

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[1] Statement of J. C. Moore, State Land Use Planning Specialist.

[2] Rules and Regulations of State Engineer, 1938.

those lands are now under permit to be irrigated from Salt Creek below the proposed point of diversion to request the State Engineer to authorize a change from the present point of diversion to the diversion which is to be constructed under the Water Facilities proposal. Such a plan will reduce the net demand 1.29 cubic feet per second, disregarding the 4 acre-feet for a log pond. This leaves the net demand of 14.335 cubic feet per second. The stream gagings show that there is sufficient water to meet a demand of 14.335 cubic feet per second 58 per cent of the days during the months of July, August, and September.

Salt Creek.--There have been 7 certificates of appropriation and 12 permits issued, making a total of 19 applications in good standing for water rights from Salt Creek and its tributaries. The earliest priority is dated July 3, 1929. Two of these rights are for reservoir storage in the stream channel, and one is for domestic and mill purposes. The total direct flow applications and appropriations are 3.62 cubic feet per second. The appropriations for storage are for 80 acre-feet to irrigate 25 acres, and permits for 13 acre-feet to irrigate 30 acres. Since it is physically impossible to impound 80 acre-feet with the dam as constructed, and becuase of the small amount stored in the other, both of the storage rights are disregarded and the areas irrigated are estimated on the basis of one cubic foot for 80 acres direct flow. These are included in the total appropriation of 3.62 cubic feet per second. Since all irrigable lands are from 30 to 60 feet above the stream bed, this necessitates pumping. During

the summer months, which have little or no precipitation, Salt Creek ceases to be a flowing stream, which necessitates the construction of ponding dams in the channel for the irrigation supply. The gradient of the stream, which was taken by barometric readings, is approximately 4 feet per mile. Existing dams are 4 to 8 feet in height. They back the water onto adjoining operators' lands. Easements have not been obtained, and, therefore, the upstream operator could, if he desired, pump the impounded water. To date this has caused no controversies of any magnitude although some trees have died from such practice. Farm units are small, and because of this it would be impossible to confine the stored water within the boundaries of the lands owned by one operator.

There are no evaporation figures available for Salt Creek basin, and therefore the records from the State College at Corvallis, which is about 35 miles south of the basin, are considered as being indicative of the losses that may be anticipated on Salt Creek. The average width of the stream channel is about 40 feet. Therefore, an 8-foot dam with 6-foot depth of water will back up the water about $1\frac{1}{2}$ miles. Under such conditions, the total water impounded would be approximately 22 acre-feet. Assuming the loss by evaporation and seepage to be 15 inches during a 3-month period, the total amount of water available for irrigation from this storage would be about 17 acre-feet. There are no gaging records on the stream, but farmers residing along the stream state that there is no run-off available from about July 1 until about September 15, and, therefore, the operators must depend entirely on storage for their irrigation supplies.

Yamhill Basin.--The following tabulation is a summary of applications filed, permits issued, and certificates issued, with the amount of appropriation asked and amount allowed for the Yamhill Drainage Basin, as taken from Plat Records, Districts 1, 2, 3, and 4, in the State Engineer's office, Salem, Oregon:

Applications	Permits	Permits Cancelled	Appli. or permits inchoate	Certificates issued	Cu. Ft. per Sec. Applied for	Cu. Ft. per Sec. Allowed	Storage in A.F. Applied for	Allowed
259	255	27	252	106	235.355	172.688	880	

The above tabulation does not include vested rights.

To obtain a certificate of appropriation for water under the Oregon laws, the following procedure must be followed:

1. Applicant must file an application in State Engineer's office stating amount of water he desires to appropriate, use, etc.

2. State Engineer issues permit if application meets requirements.

3. The permit allows the amount of water required under the data set forth in the application, and may be more or less than applied for.

4. Upon completion of construction, the applicant must make proof, setting forth the acres irrigated, water stored, etc. The State Engineer, provided the regulations and requirements have been fulfilled, issues a certificate of appropriation giving the amount of water the applicant has been allowed. This amount may be more or less than the amount applied for or than the amount allowed in the permit, but it is usually less. Until a stream has been adjudicated, it is practically impossible to arrive at definite demands on the stream.

Certificates of appropriation have been issued on the Yamhill River for 56.815 cubic feet per second. Permits for which the certificates were issued had allowed 75.225 cubic feet per second. The gaging station on the Yamhill River at Lafayette, which is below most of the main tributaries, shows the mean and minimum flow in cubic feet per second, for the period April 1 to September 30, to be as follows:

TABLE 5.—FLOW IN CUBIC FEET PER SECOND[1]

Year	April		May		June		July		August		September	
	Min.	Mean	Min.	Mean	Min.	Mean	Min.	Mean	Min.	Mean	Min.	Mean
1929	1560	2820	590	750	200	355	80	148	68	91	55	49
1930	620	787	590	705	200	322	68	110	53	54	40	60
1931	690	5550	200	405	117	234	68	116	37	55	35	72
1932	1270	2870	390	632	165	260	-	142	-	79	-	65

[1] Records in the State Engineer's "Water Resources of the State of Oregon," 1931-1936, Page 398.

Duty of Water

The duty of water varies chiefly with the type of crop and the type of soil, the yearly seasonal net requirements being approximately 18 inches.[2] Common methods of applying water in this section are corrugating, sprinkling, and flooding, where the contour of the land is sufficiently level or costs of leveling are not prohibitive. Flooding is used for pasture lands, corrugations for row crops, and sprinkling for certain types of cash crops such as truck gardens,

[2] Agricultural Experiment Station, Corvallis, Oregon, Bulletin 302, Page 9.

and berries, and also where the topography of the pasture land is undulating to rolling. The application and economy of each should be investigated before designing and estimating pumping costs.

Existing Facilities

Willamina Creek

The existing irrigation facilities consist of direct diversion and pumping. Although not in use at the present time, a pumping plant to furnish municipal water for Willamina is held ready to supplement that city's supply, which is obtained from another source. A lumber mill is using a negligible amount of water from the main stream for fire fighting, boilers, and a 4 acre-foot capacity log storage pond. The Portland General Electric Company has a dam for diversion of water to a hydroelectric plant at the city of Willamina.

All of the irrigation pumps are horizontal centrifugals, directly connected to old car engines. Most of the units are portable to facilitate moving them to higher ground during flood stage. Due to the topography of the valley, several of the farm operators have found it necessary to construct flumes to convey water to the high point of the land. This has increased the acre cost of irrigation. There are no dams on the main creek, except the one used to divert water to the Portland General Electric Company's hydroelectric plant. The operators rely on the normal flow of the creek to maintain a level high enough to facilitate pumping without channel reservoirs.

An operator on one of the tributaries to Willamina Creek has constructed a small channel reservoir for his water supply. He is able to store water for about one-fifth of the land originally called for in his permit.

Salt Creek

The existing facilities on Salt Creek and tributaries consist of pumping plants for irrigation, stationary boilers, one log pond and a sawmill. Water for the mill is supplied from a small dam. Three small channel dams 4 to 8 feet in height cause ponding as far as 2 miles upstream from each. This storage is pumped for irrigation. The pumping plants observed consisted of 4-inch horizontal centrifugal pumps, directly connected to electric motors in all but one instance. In this case, a reconditioned Buick passenger automobile engine was in use. Vertical pumping heads average about 35 feet, and discharge pipe lines vary approximately between 300 and 1,000 feet.

Land Use

Yamhill Basin was one of the first areas settled in Oregon. The early settlements, which date back to 1834, were confined entirely to the valleys. After the valley land was practically all taken, settlement occurred in the adjoining hill land.

Agriculture has always been the dominant industry. Grazing livestock on the fertile and open valleys and the growing of such

crops which could be utilized for home consumption were the first agricultural land uses. Later, with the rapid settlement of the bottom land, wheat became the important crop. The continual cropping of wheat, year after year, decreased the yields to almost half of the original production, and there resulted a trend toward dairy farming, general farm crops, fruit, truck, and other specialty crops.

There are a number of crops that are adapted to the basin. This is indicated by the variety grown in Willamette Valley, which includes Yamhill Basin. In this valley, more than fifty different crops are being successfully produced commercially.[1] However, some local areas can produce economically only a few crops due to the type of soil, and soil types vary widely in their adaptability for crop production. This is denoted in Table 4 which, based on soil types, presents for Yamhill County the approximate acreage of lands that are adapted to various types of crops.

Although a considerable portion of Yamhill County is outside the basin, the remainder of the county comprises approximately 75 per cent of the total area in the basin and the county as a whole is considered as representative of the basin from an agricultural standpoint.[2]

In the analysis of Table 4, there is indicated that in Yamhill County approximately 10,000 acres of valley land are adapted to intensive crops and 114,000 acres are adapted to general farming. Approximately

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[1] Willamette Valley Land Adaptability - Oregon State College Circular No. 120, 1937.

[2] It is estimated that a small acreage in the southern portion of the watershed in Polk County is adapted to land type number 4, as described in Table 4.

29,000 acres of hill land are well suited to orchard and general crops, while about 126,000 acres are adaptable for extensive use, such as grazing.

TABLE 4.--LAND ADAPTABILITY CLASSIFICATION
YAMHILL COUNTY[1]

Land Type No.	Type of Land	Area in Yamhill County Acres	Per cent	Area predominantly adapted for:
1	Valley	10,559	4	Intensive crops, such as vegetables, small fruits, hops, etc.
2	Valley	58,147	21	General farming, with limited production of intensive crops.
3	Valley	56,694	20	Hay, grain, and seed production.
4	Valley	-	-	Pasture, with limited production of hay, grain, and seed.
1H	Hill	29,074	10	Fruit raising and general farming.
2H	Hill	126,470	45	Pasture and extensive cropping.
	TOTAL	280,924	100	

[1] Willamette Valley Land Adaptability - Oregon State College Circular No. 120, 1937.

The present utilization of the agricultural lands in Yamhill basin is mainly for the production of grain and hay. The major type of farming is dairy farming. Tabulations made from the 1935 census, including 1,758 farms and over 80,000 acres in the basin, showed the average size per farm as 98 acres and the average crop acres as 46. The acreage utilized in crops was as follows:

Cash grain crops	35,340	acres	or 43	per	cent
Hay crops	26,022	"	" 32	"	"
Orchards	11,972	"	" 15	"	"
Other crops	8,037	"	" 10	"	"
TOTAL	81,371	"	" 100	"	"

These figures indicate that approximately 75 per cent of the present agricultural farm acreage in the basin is utilized for the production of cash grain and hay. The remaining 25 per cent is farmed more intensively in the production of fruit, vegetables, and other specialty crops.

The production of livestock is important in the basin. In Yamhill County, approximately 40 per cent of the annual agricultural income was derived from livestock during the period, 1926-1930.[1] It is believed that there has been no material change in the per cent of income since 1930. The main livestock enterprises consist of dairy, sheep, hogs, and poultry.

In an area that is adapted to a number of crop varieties, the acreage per farm may vary considerably and still each farm be an economic unit. In Yamhill County, the size in farm acreage ranges from less than 9 to over 1,000 acres. The trend since 1900 has been toward a greater number of smaller acreages resulting from subdivisions of ownerships. This is indicated in Table 5, which presents census tabulations by size of farm units for Yamhill County for the years of 1900 and 1935.

As shown in Table 5, during the years from 1900 to 1935 the total number of farms was almost doubled, while the increase in the total tillable acreage was almost nil. The greatest increases in number of farms were in tracts under 9 acres, and from 10 to 20 acres. During this period, there occurred many subdivisions on inferior

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[1] Report of the Yamhill County Agricultural Outlook Conference, 1936.

agricultural land and also a number of small orchard subdivisions on better land, which later proved to be insufficient to produce a livable income.

TABLE 5.--NUMBER OF FARMS BY SIZE, YAMHILL COUNTY

Size in acres	Number Farms in 1900	Number Farms in 1935
Under 9	78	394
10-19	102	409
20-49	270	758
50-99	266	561
100-259	548	585
260-499	237	166
500-999	78	49
1000-and over	16	13
Total number farms	1,595	2,935
Average size of farms	178	98
Total acreage tillable land	134,632	139,745

Present Land Problems

There is no localized land problem in the Yamhill Basin that can be considered as distressing. However, three land problems are recognized by county officials and the general public. These problems require attention if the future agriculture industry is to prosper. They are, namely: (1) settlement on logged-over hill lands or other lands unadapted to agricultural cropping; (2) uneconomic farm units due to small acreage; and (3) sheet erosion on hill soils. Each of these problems is described in detail.

Estimate of Lands that are not Needed in Agriculture

The County Land Use Committee in 1938 estimated that approximately 100 families were located in logged-off areas in the western border of Yamhill County. These families hold title to about 13,000 acres, of which approximately 500 acres are cultivated. The committee believes that on the average these lands are not capable of supporting a farm family wholly on agricultural production. Also, the committee estimated that approximately 65 other families located in another section of the county are farming agricultural lands that could be considered as marginal from a production standpoint.

Uneconomic Farm Units Due to Small Acreage

There are numerous operators who have insufficient acreage to farm profitably. Approximately half of the present farms in Yamhill County are so small that their operators must seek outside employment part of the year in order to obtain a livable income.[1] However, this is not necessarily a misuse as many of these small ownerships were secured by workers, employed in outside industries, who purchased small farm acreages for the purpose of supplementing their earnings from labor.

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1. Estimate of Yamhill County Land Use Committee.

Sheet Erosion on Hill Soils

Sheet erosion is confined almost entirely to hill soils but damage on many farms has been serious and costly. In some cases, fertile farm lands have been eroded to the extent that farming is no longer profitable.[1] Usually the soil losses were so gradual that they were not recognized as being serious until nearly all of the top soil was washed away and gullying was evident. On those farms where better cultivation practices prevailed, soil erosion has not caused extensive harm.

To check and prevent any serious localized problem in agriculture, adjustments are necessary for those farm operators who are located in areas not adapted for agricultural production, or who have units that are so small in acreage they are considered uneconomic, or where sheet erosion has caused fertile land to become submarginal or marginal in production. The extent of needed adjustments is not known. However, the number of Farm Security loans indicates somewhat the existing conditions. There are approximately 170[2] Farm Security Administration loan clients in the basin. These clients are not localized in any district but are distributed throughout the area. The number of farm families in the basin totals approximately 4,000, as tabulated from the 1935 census reports.

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[1] Yazhill County Land Use Committee Report, 1936.

[2] As of December, 1938.

III

ADJUSTMENTS POSSIBLE BY WATER FACILITY DEVELOPMENT

Water facility development cannot alleviate settlement problems in logged-over forested areas, or problems of sheet erosion on hill soils. It can, however, assist many of those operators who are now producing in a low capacity due to insufficient farm acreage. It would enable these operators to intensify crop production and enlarge their size of business as a result of heavier yields, thus creating more economic operating units.

The value of irrigation in the basin is dependent upon the variety of crop, the soil type, management, and other factors. In numerous cases in the past, there has been an increase in crop yields of over 50 per cent when land was put under irrigation. For general crop production, such as alfalfa hay and ladino pasture or corn, operators who are now irrigating estimate they can afford to pay as high as six to seven dollars per acre per year for irrigation water. Ladino pasture under irrigation will carry from 3 to 4 cows per acre for 6 months out of the year.[1] In the production of berries, beans, and other specialty crops, the price which operators can afford to pay for irrigation water can be higher than seven dollars per acre

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[1] Twenty-five Years of Supplemental Irrigation in Willamette Valley. Oregon Experiment Station Bulletin 302, 1932.

[illegible] have more than doubled their yields under irrigation.[1] However, in the case of specialty crops it would be very difficult to to estimate the amount an average operator could afford to pay for irrigation water.

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[1] Effect of Irrigation on Major Berry Crops in the Willamette Valley. Oregon Experiment Station Bulletin 277, 1951.

IV

PROPOSED WATER FACILITY DEVELOPMENT

Surface Water Development

The surface water problem in the Yamhill basin is not one of insufficient precipitation, but rather one of seasonal distribution and the conservation of run-off therefrom. During the months of high precipitation, the problem is one of drainage, while during the months of low precipitation, there is an insufficient water supply for maximum crop production, unless the land is irrigated.

The insurance of adequate surface water supplies to irrigate the basin extensively would require the construction of storage reservoirs on the Yamhill and its principal tributaries. Such large construction is not adaptable to the Water Facilities Program.

The possibilities of development on Willamina Creek are limited to a direct diversion canal and a pumping project. The proposed development will consist of a diversion dam and canal for the irrigation of approximately 1,000 acres of land on the east and west sides of the creek, north of the City of Willamina, as shown on the accompanying map of proposed facilities. The water will be diverted by a 10-foot dam, to be located approximately 4 miles north of Willamina. The canal will divert from the east side of the creek and follow the course of the creek about 4,500 feet. By means of a siphon, the

irrigable area.

There about 50 acres of land approximately 1 mile above the proposed diversion that are now partially irrigated by pumping. This plan can be enlarged and improved to irrigate an increased acreage if the pumping lift is increased and the existing wood flume is replaced by a discharge pipe.

Other small areas may be irrigated by pumping, provided the expense of installation per irrigated acre can be justified by more detailed studies. They appear impracticable unless possibly these areas can be devoted to the production of specialty crops, such as berries and garden truck, which lack of market outlet and other difficulties may preclude. There are no practical reservoir sites on the tributaries, and normally there is not sufficient water for direct diversion.

On Salt Creek, the possibilities for additional development are problematic. The stream is intermittent or entirely dry during the irrigation season. There are no storage possibilities, except by ponding in the creek channel. Due to the low gradient of the stream, the impounded water backs onto adjoining property. The surface exposed to evaporation is large and the cost of a suitable dam is excessive per acre-foot of water stored, and the pumping lifts range from 50 to 60 feet. The available supply would be limited and undependable, making the initial cost per acre of land irrigated extremely high. Easements for land submerged should be obtained.

If all farm operators owning land adjacent to the creek channel could be formed into a cooperative group, it would be possible to construct additional ponding dams which would tend to stabilize the stream flow, furnish stock water, and supply limited amounts for pump irrigation. The cost per acre irrigated can be justified only on the basis of raising selected crops, such as berries, garden truck, or ladino clover for pasture, the advisability of which has not been studied in this investigation.

There are possibilities for pump irrigation from the Yamhill River. Direct diversion would be possible in the upper valley, but since the owners are not yet interested in irrigation, and the water supply is insufficient, studies of these possibilities were not made. There are now many filings for water for irrigation from the river and its tributaries. These generally are for small acreages, none exceeding 160 acres. The pumping lifts range from 30 feet, in the upper valley, to 60 feet, in the lower valley.

Estimated Costs

The following tabulation considers estimated costs of constructing a diversion dam and canal on Willamina Creek on the basis of current contract prices, the dam to be constructed of concrete and creosoted timber, using flash boards to divert the water to the ditch.

Furnishing all labor and material to construct dam complete, including headgate and flash boards.	$ 4,150
Furnishing material, laying excavating, and backfilling 800 feet of syphon pipe.	3,300
Furnishing labor and equipment for canal construction	3,250
Furnishing material and installing outlet gates and measuring devices	1,500
Furnishing material and constructing a wood flume	400
Furnishing and installing 3 weirs.	450
Total.	$16,850
Plus 10 per cent for incidentals	1,685
	$18,535

Estimated Cost per Acre for Construction Charges
to Irrigate 1,000 Acres, $18.54 per acre.
Maintenance and overhead $1.00 per acre per year.

Cost per acre first year:

Interest on $18.54 @ 5%.	$ .56
Payment on principal 1/20 of $18.54. . .	.92
Maintenance and overhead	1.00
Taxes, 4% on $18.54.	.74
Total.	$3.22

Pumping costs in the Yamhill area are estimated as follows:

Conditions:

Pump yielding 350 G. P. M. net, at 40' head (.77 cubic feet per second).

Pump yielding 275 G. P. M. net, at 50' head (.61 cubic feet per second).

Power:

[illegible] to Motor [illegible] direct connected
[illegible] equipment operating at 70% efficiency
Duty of water 18 acre inches, or 1.5 acre-feet per acre
Area to be irrigated, 40 acres

Equipment:

5 inch "U" Pacific Horizontal Centrifugal Pump
5 H. P. motor direct connected single phase
5 inch suction pipe
6 inch discharge pipe, asphalt coated

Cost of Equipment:

5 inch pump and motor 5 H. P.	$[illegible]
40' 5" screw pipe suction line @ $1.00.	40.[illegible]
1 Galvanized foot valve	[illegible]
1 Reducing Ell, 5 to 3 inches	[illegible]
220 volt magnetic starting switch	[illegible]
50' 6" asphalt coated discharge line @ $.64 per lineal foot	[illegible]
600' 6" concrete distribution pipe @ $.50 per lineal foot	400.[illegible]
1 Increaser, 3 to 6 inches.	4.[illegible]
5" Gate valve	15.[illegible]
1 Priming Pump.	5.[illegible]
Hauling and installation charges.	50.[illegible]
	$876.50
Plus 10 per cent for incidentals.	87.65
Total Cost of Equipment.	$964.15

Cost per acre of land irrigated

For Equipment only:

Fixed charges	$ 94.10
Operating charges (Based on 40 acres irrigated land):	
Interest on investment $964.15 @ 5%. . . .	$28.92
Depreciation @ 10%	96.42
Taxes @ 4%	38.57
.77 cu. ft. per sec. = 1.54 A.F. 24 hrs.	
To produce 60 A.F. will require 39 pumping days	
39 days = 936 hrs.	
Power rate 10¢ per h.p. unit per hour	
936 hours at .10	93.60
	$257.31

For 50' lift. 7.50

Cost estimates for pump irrigation involve so many factors, and conditions for pumping are so variable that each installation must be analyzed to determine the most economic unit. Some factors to consider are pumping lift, type and kind of pump and power unit, location of power line, water supply, leveling field, power rate, length of discharge line, acreage to be irrigated, type of water distribution (flooding, corrugations, or sprinkling), type of crop, labor charges, continuous or intermittent pumping (this may affect power costs), and increased taxes on land.

APPENDIX.

APPENDIX

LEGAL ASPECTS

Oregon State Water Laws

The State Water Code for Oregon was passed February 24, 1909. The following paragraphs are taken from the Water Laws of Oregon, prepared under the direction of Charles E. Stricklin, State Engineer, 1931

Initiation of Rights after February 24, 1909

Water Belongs to Public—

Sec. 47-401, "All water within the state from all sources of water supply belong to the public."

Waters May Be Appropriated for Beneficial Use—

Sec. 47-402, "Subject to existing rights, all waters within the state may be appropriated for beneficial use, as herein provided, and not otherwise; but nothing herein contained shall be so construed as to take away or impair the vested right of any person, firm, corporation or association to any water;——"

Appropriation of Underground Waters—

Sec. 47-1301, "Subject to existing rights, all underground waters of the State of Oregon in counties lying east of the summit of the Cascade Mountains may be appropriated for beneficial use, as herein provided, and not otherwise, but nothing herein contained shall be construed so as to take away or impair the vested right of any person, firm, corporation, or association to use the water from any existing well or source of underground supply where such water is economically and beneficially used."

Unlawful Use of Water and Waste—

Sec. 47-713, "The unauthorized use of water to which another person is entitled, or the wilful waste of water to the detriment of another, shall be a misdemeanor, and the possession or use of such water without legal right, shall be prima facie evidence of the guilt

of the person using it. It shall also be a misdemeanor to use, store, or divert any water until after the issuance of permit to appropriate such waters."

Application: Unlawful Use or Diversion a Misdemeanor--

Sec. 47-501, "Any person, association, or corporation hereafter intending to acquire the right to the beneficial use of any waters shall, before commencing the construction, enlargement or extension of any ditch, canal, or other distributing or controlling works, or performing any work in connection with said construction, or proposed appropriation, make an application to the state engineer for a permit to make such appropriation. Any person who shall willfully divert or use water to the detriment of others without compliance with law, shall be deemed guilty of a misdemeanor. The possession or use of water, except when a right of use is acquired in accordance with law, shall be prima facie evidence of the guilt of the person using it."

Vested Rights Not Affected--

Sec. 37-502, "This act shall not prevent the condemnation for public park purposes of any lands through which any of said streams flow, nor effect (affect) vested rights or the rights or riparian proprietors of such lands in or to the waters of said creeks or streams, nor shall it prevent the condemnation of any lands through which any of said streams flow, for the purpose of establishing, maintaining and operating thereon salmon fish culture work, nor shall this act prevent the fish commission of the State of Oregon from appropriating any of said waters for fish culture work;------"

Ditches for Waste, Spring, or Seepage Water--

Sec. 47-1401, "All ditches now constructed, or hereafter to be constructed, for the purpose of utilizing the waste, spring, or seepage waters of the state, shall be governed by the same laws relating to priority of rights as those ditches constructed for the purpose of utilizing the waters of running streams; provided, that the person upon whose lands the seepage or spring waters first arise, shall have the right to the use of such waters."

Filings for water rights were not required prior to February 24, 1909. The water code does not require those with vested rights established prior to February 24, 1909 to make filings. Therefore, without detailed field surveys, it is impossible to determine all the water demands on any stream. The vested rights on the streams in the Willamette drainage have not been determined. Therefore, a comprehensive study is required to determine the status of the rights of all water users to summarize the demands.

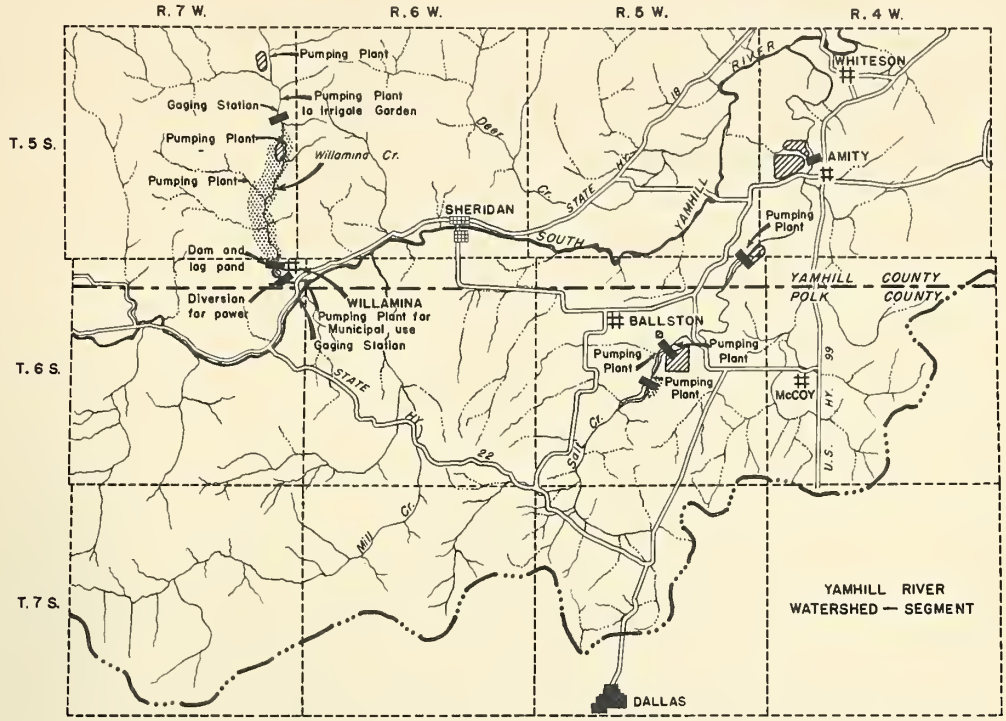
For Domestic Purposes -- 0.02 (1/50th) of a cubic foot per second is considered sufficient for the use of one family.[1]

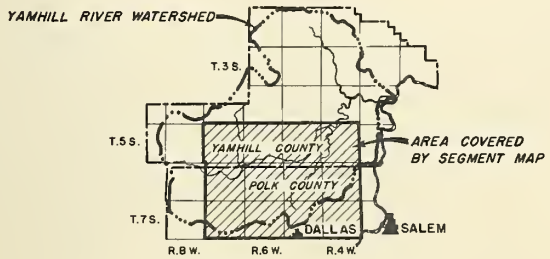
For Irrigation Purposes -- 0.0125 (1/80th) of a cubic foot per second is, under ordinary conditions, considered sufficient for the irrigation of an acre of ground. When an appropriation is made from a stream which has been adjudicated and the duty of water determined, the quantity of water allowed for each acre shall not exceed the duty prescribed by the court's decree.[1]

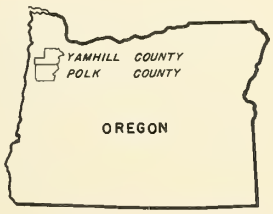
MAP I

YAMHILL RIVER WATERSHED — OREGON

WATER FACILITIES







DIVERSION DAM

CHANNEL RESERVOIRS

IRRIGATED AREA

PROPOSED IRRIGATION

PUMPING PLANTS MAY BE INSTALLED TO IRRIGATE LIMITED AREAS ADJACENT TO THE MAIN DRAINAGES, PROVIDED IT IS DEFINITELY DETERMINED IN EACH INSTALLATION THAT THERE IS SURPLUS WATER AVAILABLE OVER AND ABOVE PRIOR APPROPRIATIONS.

MAP II-M-443 PREPARED BY THE CARTOGRAPHIC UNIT B.A.E

U. S. DEPARTMENT OF AGRICULTURE BUREAU OF AGRICULTURAL ECONOMICS
DIVISION OF LAND ECONOMICS
WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

YAMHILL RIVER WATERSHED
YAMHILL AND POLK COUNTIES
OREGON

SCALE 1 0 1 2 3 MILES

REFERENCES:	COOPERATING AGENCIES:
SEE TEXT	SEE TEXT

DATE AUGUST 1939 SHEET I. OF I.	WATER FACILITIES